WHAT IS CLAIMED IS:

1. A compression ratio controlling apparatus for a spark-ignited internal combustion engine, comprising:

a variable compression ratio mechanism that is enabled to operatively vary a compression ratio of the engine;

a detecting section that detects an engine speed and an engine load; and

a compression ratio controlling section that controls the variable compression ratio mechanism on the basis of the detected engine speed and engine load in such a manner that the compression ratio is varied toward a target high compression ratio when the engine load falls in a predetermined low load region and toward a target low compression ratio when the engine load falls in a predetermined high load region, the compression ratio controlling section providing a predetermined delay for a variation in the compression ratio toward one of the target high and low compression ratios at a time at which a transient state of the change in the engine load occurs in accordance with at least one of an engine driving history immediately before the transient state thereof occurs and a wall temperature of a combustion chamber of the engine immediately before the transient state thereof occurs.

2. A compression ratio controlling apparatus for a spark-ignited internal combustion engine, comprising:

a variable compression ratio mechanism that is enabled to operatively vary a compression ratio of the engine;

a detecting section that detects an engine speed and an engine load; and

a compression ratio controlling section that controls the variable compression ratio mechanism on the basis of the detected engine speed and engine load in such a manner that the compression ratio is varied toward a target high compression ratio when the engine load falls in a predetermined low load region and toward a target low compression ratio when the engine load falls in a predetermined high load region, the compression ratio controlling section controlling the variable compression ratio mechanism to vary the compression ratio toward one of the target high and low compression ratios in such a manner that the varied compression ratio reaches to the one of the target high and low compression ratios after a passage of a predetermined period of time from a time at which a transient state of a change in the engine load occurs.

3. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 2, wherein the compression ratio controlling section controls the variable compression ratio mechanism to vary the compression ratio toward the target high compression ratio in such a manner that the varied compression ratio reaches to the target high compression ratio after the passage of the predetermined period of time by delaying a variation speed of the compression ratio which varies toward the target high compression ratio when the engine falls in the predetermined low engine load from the

target low compression ratio when the engine falls in the predetermined high engine load.

4. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 2, wherein the compression ratio controlling section sets at least one intermediate target compression ratio between the target high compression ratio and the target low compression ratio and controls the variable compression ratio mechanism to vary the compression ratio in a stepwise manner along the intermediate target compression ratio.

5. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 1, wherein the compression ratio controlling section starts a control of the compression ratio via the variable compression ratio mechanism to be directed toward the target high compression ratio after the transient state occurs after the predetermined delay in time has passed from a time at which the transient state in the change of the engine load occurs.

6. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 2, wherein a state of a wall temperature of a combustion chamber of the engine when the transient state in the change of the engine load occurs is detected or estimated and, as the wall temperature of the combustion chamber becomes higher, the predetermined period of time is set to become longer.

7. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 5, wherein a state of a wall temperature of a combustion chamber of the engine when the transient state in the change of the engine load occurs is detected or estimated and, as the wall temperature of the combustion chamber becomes higher, the predetermined delay in time is set to become longer.

8. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 2, wherein the compression ratio controlling apparatus further comprises a coolant temperature detecting section to detect a temperature of a coolant of the engine and, as the temperature of the engine coolant becomes higher, the predetermined period of time is set to become longer.

9. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 2, wherein the compression ratio controlling section controls the variable compression ratio mechanism to vary the compression ratio toward the target low compression ratio in such a manner that the varied compression ratio reaches to the target low compression ratio after the passage of the predetermined period of time from the time at which a transient change in the engine load from the predetermined low load region to the predetermined high load region occurs.

10. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed

in claim 9, wherein the compression ratio controlling section controls the compression ratio mechanism to vary the compression ratio toward the target low compression ratio in such a manner that the varied compression ratio reaches to the target high compression ratio after the passage of the predetermined period of time by delaying a variation speed of the compression ratio which varies toward the target low compression ratio when the engine load falls into the predetermined high engine load region from the target high compression ratio when the engine falls in the predetermined low engine load region.

11. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 9, wherein the compression ratio controlling section sets at least one intermediate target compression ratio between the target low compression ratio and the target high compression ratio and controls the variable compression ratio mechanism to vary the compression ratio in a stepwise manner to vary the compression ratio along the intermediate target compression ratio toward the target low compression ratio when the transient state of the change in the engine load of the change in the engine load from the predetermined low load region to the predetermined high load region occurs.

12. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 9, wherein the compression ratio controlling section starts a control of the

compression ratio via the variable compression ratio mechanism to be directed toward the target low compression ratio after a predetermined delay in time has passed from a time at which the transient state in the change of the engine from the predetermined high load region to the predetermined low load region occurs.

13. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 9, wherein a state of a wall temperature of a combustion chamber of the engine when the transient state in the change of the engine load from the predetermined low load region to the predetermined high load region occurs is detected or estimated and, as the wall temperature of the combustion chamber becomes lower, the predetermined period of time is set to become longer.

14. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 12, wherein a state of a wall temperature of a combustion chamber of the engine when the transient state in the change of the engine load occurs is detected or estimated and, as the wall temperature of the combustion chamber becomes lower, the predetermined delay time is set to become longer.

15. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 9, wherein the compression ratio controlling apparatus further comprises a coolant temperature detecting section to detect a temperature

of a coolant of the engine and, as the temperature of the engine coolant becomes higher, the predetermined period of time is set to become shorter.

16. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 9, wherein a turbo charger is equipped in an intake air system of the engine and, when a turbo charge pressure is equal to or higher than a predetermined turbo charge pressure, the compression ratio is quickly varied without the predetermined period of time during the transient state of the change in the engine load from the predetermined low engine load region to the predetermined high engine load region.

17. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 7, wherein the state of the wall temperature of the combustion chamber is estimated according to the driving history immediately before the transient state occurs.

18. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 7, wherein the wall temperature of the combustion chamber is detected by a temperature sensor.

19. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 1, wherein the variable compression ratio

mechanism comprises a multiple link piston-crank mechanism including; a first link linked to a piston via a piston pin; a second link swingably linked to the first link and rotatably linked to a crank pin portion of an engine crankshaft; and a third link swingably linked to the second link and swingably linked to the second link and swingably supported on an engine body and wherein the compression ratio controlling section varies a position of a fulcrum of the third link of the multiple link piston-crank mechanism with respect to the engine body to perform a variable control of the compression ratio.

20. A compression ratio controlling apparatus for a spark-ignited internal combustion engine as claimed in claim 1, wherein the compression ratio controlling apparatus further comprises an ignition timing controlling section that controls an ignition timing of the engine and an engine knock detecting section detects an engine knock and wherein the ignition timing controlling section retards the ignition timing of the engine when the engine knock detecting section detects the knock.

21. A compression ratio controlling method for a spark-ignited internal combustion engine, the engine comprising:

a variable compression ratio mechanism that is enabled to vary a compression ratio of the engine, and the compression ratio controlling method comprising:

detecting an engine speed and an engine load;

controlling the variable compression ratio mechanism on the basis of the detected engine speed and engine load in such a manner that the compression ratio is varied toward a target high compression ratio when the engine load falls in a predetermined low load region and toward a target low compression ratio when the engine load falls in a predetermined high load region; and

providing a predetermined delay in a variation in the compression ratio toward one of the target high and low compression ratios at a time at which a transient state of a change in the engine load occurs in accordance with at least one of an engine driving history immediately before the transient state thereof and a wall temperature of a combustion chamber of the engine immediately before the transient state thereof occurs.